PROJECT FACT SHEET

CONTRACT TITLE: Seismic Attenuation Attributes for Reservoir Characterization

ID NUMBER: DE-FC26-01BC15356

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PROJECT SITE
CITY: Houston **STATE:** TX
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CONTRACT PERFORMANCE PERIOD:
10/1/2001 to 9/30/2003

PROGRAM: Exploration & Production
RESEARCH AREA:
PRODUCT LINE: ADIS

CO-PARTICIPANTS:

PERFORMER:	**CITY:**	**STATE:**	**CD:**
PERFORMER:	**CITY:**	**STATE:**	**CD:**
PERFORMER:	**CITY:**	**STATE:**	**CD:**
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FUNDING (1000'S)	DOE	CONTRACTOR	TOTAL
PRIOR FISCAL YRS	190	63	253
FY 2002 CURRENT OBLIGATIONS	285	63	348
FUTURE FUNDS	279	63	342
TOTAL EST'D FUNDS	754	189	943

OBJECTIVE: The general objective of this 24-month study is to develop a simple and effective methodology for estimating reservoir properties (in particular, oil and gas saturation, but also lithology, porosity, and permeability) from seismic attenuation attributes. Methods developed will be used to analyze field data sets to be provided by the oil industry. This project will provide:

Additional petrophysical insight from acquired data
Increased understanding of rock and fluid properties and fluid flow
Techniques to measure reservoir properties that are not currently available
Tools to more accurately describe the reservoir and predict oil location and volumes.

PROJECT DESCRIPTION:

Background: Seismic dispersion and attenuation as a tool for hydrocarbon exploration and exploitation has been understood in principle for many years (Knopoff, 1964; Hermont, 1969; Kuster and Toksoz, 1974). However, it is only now becoming technically viable owing to the recent tremendous advances in seismic data quality and computing (Rapoport, M. B. and Ryjkov, V. I., 1994, Rapoport, et al, 1997). Historically most attempts to use inelastic rock properties in real world geophysical applications were doomed by the inadequate state of amplitude and phase preservation in commercial seismic surveys. However, this has been changing rapidly and will continue to advance in the coming years.

Work to be Performed: The project will be carried out as a series of inter-related tasks as shown below.

Task 1: P and S Wave Q Pseudo-Logs: Use conventional well log data (sonic, density, gamma, neutron, resistivity, etc.) to compute the expected background Q of the formations of interest. This information is essential for generating Q dependent synthetic seismic traces (Task2).

Task 2: Q Measurement from Well Logs: In this task we will obtain some actual downhole Q measurements using existing commercial monopole and dipole sonic tools. These measurements will be used to test the validity of the rock physics computations from Task 1.

Task 3: Synthetic Seismic Modeling with Q: Use P wave velocity, S wave velocity, density, Qp and Qs to compute synthetic seismograms at varying offset angles. The sensitivity of these synthetics seismograms to perturbations of reservoir properties will be observed and used to calibrate field seismic response.

Task 4: Attenuation and Dispersion from Seismic and Link to Well Data: In this task we will focus on developing methods for extracting accurate Q information from field reflection seismic data. Different methods will be used to achieve low, medium, and high resolution. Data from vertical seismic profile (VSP) type surveys will be used to improve the results. Artificial neural network (ANN) and other techniques will be used to link the field derived Q data to the well log derived reservoir properties. Other seismic attributes such as amplitude variation with offset (AVO) and acoustic impedance will also be employed.

Task 5: Testing with field data: In this task, we will test and refine the methods we have developed using data from at least four different US oil and gas producing regions. We will require 3D seismic data volumes, well log data, and possibly core samples. Data and samples will be obtained from oil and gas industry co-funding sources. Results of the Q-based reservoir characterization will be compared to control wells and "blind" wells that will be withheld from the original data analysis.

PROJECT STATUS:

Current Work: Our current work on this project focuses on three main areas. First is the development of an attenuation method for seismic data based on Gabor-Morlet joint time-frequency decomposition. This new method will be tested and compared to results derived from conventional spectral ratio techniques. The second area of current work is in generation of synthetic seismograms with the effects of Q included. We are in the process of comparing several different approaches to this problem and we are testing three different commercial software packages to determine which if any are suitable. The third area of development is in rock physics based Q pseudo-log computation. We are developing a set of algorithms that can transform conventional well log curves such as porosity, Vshale, and water saturation.

Scheduled Milestones:

Compute Q in the depth domain from conventional well log curves.
Compute Q from full wave sonic logs (if data available)
Generate synthetic seismograms with effects of scattering and intrinsic Q to transform depth domain Q to time domain Q from logs
Compute Q from 3D seismic data in time domain
Establish a calibration between the seismic attributes and well log derived Q by appropriate linear or non-linear methods.

Accomplishments: As this project has just begun, there are no accomplishments to report at this time.

TECHNOLOGY TRANSFER:

Technology/Information Transfer: None to report at this time.

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Updated By: **Dr. Joel D. Walls** Date: **1/2/2002**